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ABSTRACT

Data for this analysis of classroom instruction were part of the junior high phase of the Managing Academic Tasks (MAT) study (Doyle, Sanford, Clements, French & Emmer, 1983). The MAT focuses on the character of academic tasks, the nature of the overall task systems that operate in classrooms, and the contexts associated with task accomplishment. The MAT is based on a definition of curriculum as a set of tasks students accomplish. The role of active content instruction in the task systems of four junior high school classes, two in science and two in English, was examined. Case descriptions focus on the circumstances and nature of observed instruction, its relation to students' work, cognitive focus, pedagogical strategies, and problems teachers appeared to encounter in conducting instruction. Analyses suggest that instruction and instructional problems should be considered in the light of the tasks in which instruction is embedded. It is suggested that the concept of content instruction as a resource for student task accomplishment might serve as a useful way for secondary teachers to think about their teaching. (Author/JD)

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The University of Texas at Austin

(R&D Rep. 6188)

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Presenting, Explaining, Assisting:

Content Instruction in Junior High Classrooms

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Abstract

This paper examines the role of active content instruction in the task systems of four junior high classes, two science and two English. Case descriptions focus on the circumstances and nature of observed instruction, its relation to students' work, cognitive focus, pedagogical strategies, and problems teachers appeared to encounter in conducting instruction. Analyses suggest that instruction and instructional problems should be considered in light of the tasks in which instruction is embedded.

Presenting, Explaining, Assisting:

Content Instruction in Junior High Classrooms

In recent years some investigators have called attention to the apparent low amount and poor quality of direct teacher instruction in classrooms. For example, Ward and Tikunoff (1982) reported that in many junior high classrooms they observed, students spent large amounts of time working on worksheets, with little active assistance or explanation from the teacher. Duffy and McIntyre's 1982 study of teacher instruction behaviors in elementary reading groups in four classes indicated that very little explicit instruction was provided to students. In a recent survey of effective teaching practices, Brophy (1982) commented on the need for more active content instruction in classrooms:

> We need a renewed emphasis on the role of the teacher as an instructor and not just as an instructional manager. Students need teachers, in general, to see that they learn efficiently and specifically, to resolve their confusions and correct their mistakes. To do so effectively, however, teachers will have to learn to meet students' needs for advance organizers, integrating concepts, detailed explanations, overt statements of relationships among concepts and between concepts and operations, and corrections of persistent misconceptions. (p. 12)

Good and Hinkel (1982) also recommended, "Some teachers need to concentrate a greater proportion of instruction to demonstrating to students the meaning of concepts and the relationships among concepts (i.e., less time in poorly defined seatwork tasks)."

This paper describes content instruction in four junior high school classrooms, two science and two English, included in the Managing Academic Tasks Study. The analysis included examination of all of the occasions and settings in which verbal teacher behaviors of presenting,

explaining, and assisting students with their work were observed in each class during 6 or 7 weeks of observation. The purpose of the study was to describe (a) the role of instruction in the task systems in these classes; and (b) the nature of instruction observed, including cognitive focus of presentations and pedagogical strategies. In addition, attention was focused on problems teachers appeared to have encountered in conducting instruction, particularly with regard to aspects of instruction that other research suggests are potentially important. Thus, the study explored the role of instruction in different kinds of task systems and content units in secondary classrooms.

Background

There is ample evidence that instruction--teacher explanation and instructional verbal interactions with students--can be a significant factor in students' learning. For recent, comprehensive reviews of instruction research, see Brophy and Good (in press) and Rosenshine (1983). Most studies of instruction have focused on specific aspects of teachers' instructional roles or on isolated lessons. Such studies have generated findings about questioning strategies and cognitive level of interactions during whole-class lessons (e.g., Ryan, 1973; Tamir, 1981; Tobin & Capie, 1982). Studies of clarity in teacher presentations (e.g., McCaleb & White, 1980; Smith & Bramblet, 1981; Smith & Land, 1981) have demonstrated negative effects of vagueness terms, verbal mazes and other distractors, and positive behaviors that emphasize structure, logical sequencing, and calling attention to key objectives.

Some recent studies of instruction have examined instruction more comprehensively, with more attention to the content of instruction and student conceptual development in relation to the content. Anderson,

Smith, and Roth (Roth, Anderson, & Smith, 1983; Smith & Anderson, 1984) studied 11 intermediate science classrooms over a 2-year period, focusing on three instructional units. The classes they studied used a variety of instructional activities, some textbook centered and others student-activity based, and in the second year of the study some teachers used instructional materials developed by the researchers. To investigate instruction in relation to curriculum materials, teacher thinking, and student performance and learning, these researchers collected a variety of data, including classroom observations of the teacher and targeted students, clinical interviews of target students, interviews of teachers, and pre- and post-tests of student learning on specific, key concepts. In general, Anderson and his colleagues found that in classes where instruction was more effective (i.e., larger proportions of students demonstrated accurate basic understanding of the key concepts that were taught), teachers emphasized and focused clearly on the key concepts, gave students practice applying concepts to common phenomena, explicitly addressed student misconceptions and contrasted them to accurate concepts, and were systematic and persistent in making sure students applied principles accurately (e.g., they insisted that students clarify vague or incomplete answers during class discussions). Their explanations focused on meaning behind scientific facts, and class discussions included both open-ended interactions to elicit student ideas and structured discussions to communicate scientific concepts clearly.

In a different content area, a recent study by Roehler, Duffy, and Meloth (1983) investigated teacher explanations during fifth-grade reading instruction. Their study focused on characteristics of teacher

explanations that appeared to be related to student awareness of comprehension processes or cognitive strategies. Qualitative differences they reported between effective and less effective explanatory teacher talk included explicit teacher emphasis on mental processing (e.g., modeling or talking through mental processes, emphasis on reasoning behind answers); monitoring student understanding; making explicit connections to previous lessons; and frequent references to situational contexts in which learning would apply. A broad review of recent literature relating to teaching of problem solving knowledge and skills (Heller, Reif, & Hungate, 1983) emphasized importance of some of the same teaching behaviors: making solution processes explicit, getting students to verbalize processes, emphasizing qualitative understanding of concepts and problems as well as procedures, and helping students resolve conflicts between their own conceptions and technically correct ones.

Data for the present analysis of classroom instruction were part of the junior high phase of the Managing Academic Tasks (MAT) study (Doyle, Sanford, Clements, French, & Emmer, 1983). The MAT is an investigation of academic work in secondary classrooms. It focuses on the character of academic tasks, the nature of overall task systems that operate in classrooms, and the events and contexts associated with task accomplishment. The MAT is based on a definition of curriculum as a set of tasks students accomplish. Each task is characterized by a product (e.g., words in blanks on a worksheet, a descriptive paragraph); operations to produce the product; resources students are supposed to use; and a value or weight in the classroom accountability system (e.g., counts as a daily grade or counts as a third of the 6-weeks grade).

Thus in the MAT, content instruction is conceptualized mainly as a resource for students to accomplish tasks. As a key component of the overall work system in a class, instruction affects the nature of tasks and their learning outcomes.

Methods

Sample

The present content instruction study focused on four junior high classes, two English and two science, which were included in the MAT study. Teachers were selected for the MAT on the basis of (a) classroom management and organization competency, and (b) evidence that the teacher attempted to use a variety of types of tasks including some tasks addressing higher cognitive objectives. For the two English classes, prior class achievement test scores were also available as evidence that these teachers were effective in teaching content of the curriculum. Because no achievement test scores were available for science classes, nominations of science teachers, based on criteria (a) and (b) above, were solicited from three sources: school district curriculum coordinators, school principals, and university student teacher coordinators. Teachers nominated independently by two or three sources were contacted. In all content areas, teachers were observed and interviewed by research staff before selections were made.

Data Collection

Data for each class in the MAT consisted of daily observations, examination of all graded student work and instructional materials, and interviews with teachers and selected students. Except for reliability observations, major responsibility for data collection and preliminary analysis was assigned to a single research staff member for each class.

During each observation the observer took notes for a narrative description of classroom events and circumstances affecting academic tasks. When possible, the observer recorded verbatim task-related statements and samples of instructional interaction to illustrate the content, focus, and strategies of instruction used by the teacher. As soon as possible after observations, observers dictated complete narratives on tape.

Analysis Procedures

Once the observations were completed and narrative records were typed, observer/analysts began a detailed analysis of the tasks seen in their assigned teacher's classes. Information obtained from class observations, instructional materials, student products, and interviews of teachers and students was used to produce: (a) topic and task lists, (b) task analyses, (c) teacher/task system summaries, and (d) case studies of selected students. Procedures for this phase of anlysis were described by Doyle et al., (1983).

Task descriptions, teacher/task system summaries, and some of the student case studies resulted in some information about the role of content instruction in classes observed. To get a more detailed picture of content instruction in each class, all of the narratives for classes in the present study of instruction were read and individual instructional episodes were identified and analyzed. Instruction was defined as verbal, content- or task-oriented teacher behaviors, including presentation, explanation, recitation conducting, discussion, and assistance of students. Instructional episodes were defined as segments of class time during which active instruction was occurring, each segment generally characterized by (a) a content focus (topic or

lesson); (b) a format (whole class, small group, individual students, or combinations); (c) initiating circumstances (planned presentation or lecture, response to students' questions or requests for assistance, response to student or class performance, or review/discussion of a completed assignment). Time in which students were working on tasks was counted as instructional time only if the narrative indicated that the teacher was providing instruction to individual students or groups steadily during that time segment. For example, if students worked for 15 minutes while the teacher went from student to student answering questions and providing instruction, these 15 minutes were counted as an instructional episode directed to instructing individual students. If, however, the teacher mainly monitored student behavior and performance but answered two students' academic questions in the 15 minutes the time was not counted as an instructional episode. Occasional, brief, or isolated instances of teacher explanations to individuals during student seatwork were not counted as instructional episodes, although they were noted. Because MAT data did not include transcripts of actual tape recorded interactions, it was not possible to count all instructional time accurately. However, any instructional interactions which the narrative indicated lasting more than 2 minutes was counted.

As class narratives were read, each instructional episode was identified and summarized. The following information was recorded: date and page of narrative, topic, format, initiating circumstance, number of minutes, and a synopsis of the episode with notes of pedagogical strategies, cognitive focus of instruction, problems that occurred, and emerging themes.

After all narratives for a teacher were read, quantitative

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summaries of instructional episodes and instructional time for each teacher were completed. These data, summarized in Table 1, are discussed in the case descriptions that follow. In addition, all of the instructional episode synopses were studied and themes that emerged within each class and across classes were identified. The instruction synopses and narratives for each teacher were then searched to identify examples and illustrations relevant to each theme.

Finally, case descriptions of instruction observed in each class were compiled. These case descriptions addressed the following questions.

1. When and under what circumstances did content instruction occur? How prominent a feature was it?

2. How did instruction relate to other task system components (e.g., student assignments, accountability or grading systems, resources other than instruction) in this class?

3. What was the nature of instruction observed, including cognitive focus, pedagogical strategies, and problems that teachers appeared to encounter in conducting instruction?

The following sections of this paper contain case descriptions of instruction in each of the four classes studied. The final section of the paper will compare the functions of content instruction and instructional behaviors across the four different classes and discuss the cases in light of some research on instruction and student achievement.

The Case Descriptions

Ms. Hart's Science Class

In Ms. Hart's eighth-grade science class, active instruction was a prominent feature. A lot of time was spent in class discussion of tasks and work on laboratory investigations with active teacher assistance and tutoring of students during tasks. Instruction in two content units were observed: (a) measurement systems, metrics, and laboratory measurement; and (b) scientific research methods. The class spent 7 weeks on these two units. Thus, compared with the standard curriculum, the amount of content covered could be considered low. In addition, student engagement was not uniformly high; not all class time was used efficiently. On the other hand, Ms. Hart's students engaged (usually intently and with some degree of success) in assignments that included higher order questions and process skills as well as recall or procedural requirements.

Occurrence of content instruction. Table 1 shows that during about half of observed class time Ms. Hart was engaged in instructing the class or working with individual students or small groups. About two-thirds of this active instruction time was spent in whole-class presentation, recitation, and discussion. About 30% of the instruction observed was directed to individuals, small groups, or mixtures of individuals and groups. This occurred while students were working on tasks. During much of the laboratory or seatwork time, Ms. Hart was actively engaged in helping individual students or groups of students as well as monitoring and directing their work.

Each unit began with brief teacher presentation and one or more minor tasks (e.g., read information handout and answer questions, view

movie and take notes, write rationale statements for steps in research methods). Discussions and instruction during and following these tasks assisted students in accomplishing subsequent tasks, which were laboratory focused assignments and related questions. Discussions following laboratory assignments served as preparation and review for culminating unit tests. In addition, some students completed extension activities required for A or B grades, and some teacher instruction was directed toward helping a small number of students with these assignments.

Content instruction--task relationships. In Ms. Hart's class most whole-class instructional episodes consisted of explanations and concept development associated with reviewing (checking and discussing, not grading) assignments after completion. These discussions served as content instruction for ensuing tasks and the culminating tests, in which students were allowed to use notes. Instructional episodes preceding some tasks focused more on directions and procedures than content. It was in instruction following minor and major tasks (in preparation for ensuing tasks) that most concept development took place during instruction in this class. Ms. Hart questioned students, commented and expanded on their answers, and provided explanations, examples and illustrations of concepts. These instructional episodes included emphasis on student understanding of their work and on reasoning behind answers. For example, in the following excerpt the class was discussing a major lab assignment that was turned in the day before. Question 11 was "a. Was this a controlled experiment? b. If yes, why? If no, how could you make it a controlled experiment?":

> Ms. Hart says that part "b" was more important. She asks the class for the answer. Tim volunteers, saying that it was a controlled experiment because, "You measured out everything carefully." Ms. Hart replies that she could measure carefully for an uncontrolled experiment, also. She asks, "What is the first criterion for a controlled experiment?" Nicole answers that conditions have to stay the same. Ms. Hart says, "Conditions for what?" Nicole answers, "The experiment and the control." Ms. Hart says, "So you have to have two parts. Did this experiment have two parts?" Several students answer yes and no, calling out. Ms. Hart replies that students who said there was only one part were wrong. She describes the two parts that this experiment had, but then she says, "This still doesn't make it a controlled experiment." She says there is one more criterion. . . . Ms. Hart asks again, "What else has to be characteristic of a controlled experiment?" Tim answers that the two parts have to be the same except for one variable. Ms. Hart asks what the test variable was in this case. Several students answer, "Gas in the bag." Ms. Hart writes "gas" on the board. She asks what the control variables were, and many students participate, calling out other variables in the experiment: the bag, the rubber band, the soda, the acid. Ms. Hart writes these on the board.

One advantage of conducting content instruction after students completed related assignments was that examination of student products gave the teacher information about student understanding and misconceptions. For example, in the discussion after the laboratory on bouyancy:

> Ms. Hart says that many people put the following answer, which she says is good reasoning though wrong. They put that the gravity on the weight was less under water. Ms. Hart asks how many students in here said that gravity was less under water. . . . She draws a diagram on the board showing conteracting forces of gravity and bouyancy on objects. She asks what bouyancy is doing to gravity in these diagrams. David R. calls out, "Counteracting it." Ms. Hart says this is right. "So gravity is not being reduced. It is being counteracted." Next, at 11:32, the teacher asks the class to consider what would happen if the force of gravity and the force of bouyancy were equal on an object. She asks them how their results would have changed in that case.

Although instruction was often organized and structured around assignments students had completed, it was not strictly limited to content of those assignments. Sometimes Ms. Hart used an introductory, minor task as a starting point for discussion of concepts in a new unit.

Other times she introduced new, related ideas in review of a major assignment.

Content instruction strategies and problems. The task system in Ms. Hart's class was characterized by linear development of relatively few concepts across a number of tasks, with repetition of major concepts in different contexts. For example, the concepts of mass and weight were introduced in Task 1 on January 20 and were a focus of instruction in four ensuing tasks across 6 weeks of work, with repeated discussion in class. Concept relationships across a series of tasks does not insure that relationships among tasks will be apparent in instruction. However, Ms. Hart's instruction tended to emphasize relationships, with frequent references to past and future tasks and questions that encouraged students to refer to past tasks for information or concept applications. For example, in the following excerpt immediately after introduction of a new term, "data", she tried (somewhat unsuccessfully) to get students to recall elements of their last lab assignment and identify the data they collected.

> Ms. Hart emphasizes the definition of data which is, "Data are the facts that a scientist obtains by doing an experiment. These facts may prove or disprove an hypothesis." Ms. Hart asks the class, "What were the data that you obtained in Part B of the last lab that you did?" The first student who volunteers says something about using a thermometer. Ms. Hart says, "But what were the data?" Tim answers immediately, saying something about the boiling point. Ms. Hart says that this is not quite right. She calls on David R., who says something about the conclusion. Ms. Hart says, "That's not your data." Then she asks the class, "What were the observations that you made?" Frances answers correctly, "The temperature." Ms. Hart says, "Yes, the temperatures were the data that you collected. Could you have ever found the boiling point without that information?" (2/10/83, p. 5)

Another way that Ms. Hart sometimes structured information in her presentations was by reviewing main points during and at the end of

discussions and verbally signalling important information. These practices may have been particularly helpful to students in this class because this teacher often seemed to have difficulty maintaining focus on main ideas during presentations. Sometimes detracting content was introduced by student comments or questions. Other times, Ms. Hart's explanations shifted from central facts and processes to incidental content. For example, on 2/9/83 in a discussion of scientific methods, Ms. Hart stated, "Some great scientists have made discoveries by looking over past work or by rethinking their own past work, sometimes by accident." To illustrate this point she told about Alexander Fleming's discovery of penicillin. This led to a discussion of the terms "antibiotic" and "penicillin". Then Ms. Hart introduced the story of the discovery of radium, referring to a recent television program. This started a brief off-task discussion of television programs. The radium story was quickly resumed, but ended with a discussion of past practices of painting watch dials with radium and modern improvements in safety regulations for use of cancer-causing substances. On this occasion, instruction did not include restatement of the main idea relating to scientific methods. On another occasion, beginning with a discussion of a specific chemical reaction (which was related but not critical to the main point of the task they were discussing) there were discussions of carbon dioxide, its use in cleaning batteries, properties of car antifreeze, component of gases in air, and the greenhouse effect and its causes.

Except for information gleaned from students' written assignments, whole class instruction in Ms. Hart's class frequently seemed to proceed with little teacher information about the immediate

understanding of the majority of students in the class. This happened because the dominant mode of student response was to volunteer responses, often by calling out. Observers frequently noted that less than one-third of the class provided student responses, although almost all appeared to attend very closely to discussions. Sometimes only two or three students participated steadily and appeared to set a pace that may have been beyond other members of the class. Because of the teacher's discussion practices and participation patterns in this room, Ms. Hart did not identify and correct misunderstandings of many students. Her usual manner of response to student answers was to simply wait for the response she wanted to hear, repeating the question and providing more information if necessary. When she got the response she wanted, she repeated it, expanded on it, and explained. Only sometimes did she directly address and correct the incorrect responses she heard during discussion. (She did, however, discuss some student errors and the reasoning behind them, after she had checked assignments handed in or examined student work in progress.) On a few occasions, the teacher began instructional episodes by calling on nonvolunteers as well as volunteers, but she did not persist in this strategy long, usually reverting to accepting called out responses from those students who were most eager to participate.

During laboratory or seatwork time Ms. Hart often provided instruction to individuals or small groups. Although the content of some teacher/student interactions were not heard or recorded by observers, many examples were recorded, and these suggest the nature of assistance she often provided. This assistance took the form of questioning students, demonstrating, pointing out key words, providing

props or models to help students reason, directing them to sources of information, or providing answers to questions. Usually students' procedural questions were answered directly, but content questions were usually answered by teacher questions, demonstrations, or other indirect strategies. For example, while students worked on questions related to lab work, there was much interaction with the teacher. In the following excerpts Ms. Hart uses demonstrations to help students answer their own questions:

> Emery is still talking to the teacher about the answer to Question 7. He argues over whether chalk dust is a solid. Ms. Hart has him state the three states of matter, liquid, gas, and solid. She asks him if chalk dust is a liquid. He says, "No." "Gas?" Student--"No." Ms. Hart then takes a small piece of chalk and asks him if it's a solid. He says, "Yes." She smashes it with the bottom of a cylinder. After she smashes it a while she asks him if it's still a solid. He says, "Yes." She smashes it some more to make the point and asks him if it's still a solid. He says, "Yes." Ms. Hart says, "Well, there's your answer." By now everyone in the room is listening. The exchange is loud.

> Ms. Hart goes to the back desk where she demonstrates something at lab Table 5 for Jorge, Walter, and Maijing. . . . She puts something heavy on the balance and says, "I can balance it, but would it be accurate?" The students answer, "No." Ms. Hart asks, "Why?" One student says, "Because there's no marks." Ms. Hart says, "That's right." The student says, "That's the answer?" Ms. Hart clarifies that a better way to say the answer would be that you cannot get an accurate reading if there's no calibration, but she tells them to use their own words. (2/2/83, p. 9)

> Sara asks Ms. Hart a question about the effect of the weight touching the sides of the glass. . . . Ms. Hart does not give Sara the answer. She tries to give her an extreme example: "What if the weight was touching the bottom of the glass?" Sara doesn't get the point. Ms. Hart tells Sara to go get a weight and they'll set up a demonstration. (2/16/83, p. 5)

Other times the teacher helped students interpret the question or gave them clues:

> Ms. Hart goes to Sandra, who has asked her a question. Instead of answering, Ms. Hart reads the question and says the key word is "completely accurate". They discuss issues of packing down (of powdered substances in graduated cylinders). (2/2/83, p. 7)

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Finally, Ms. Hart assisted a small group of low achieving students with lab procedures by questioning and directing them:

> Ms. Hart goes to Jorge and Dave, who are working on Activity 1, but who have started out wrong already. She says, "I want 11.5 grams of baking soda." Jorge says, "This is baking soda." Ms. Hart says, "What else have you got on that balance pan?" Jorge says, "Petri dish." She asks, "How are you going to figure out the weight of the soda?" Jorge guesses, "Take 10 away?" Ms. Hart asks him why. He hesitates, then sees the light, saying, "Oh, we've got to weigh the dish first!" Ms. Hart says, "Yes," and Jorge says, "See, Dave?" Ms. Hart says, "That's all right." She tells them to clean the petri dish out well before weighing it. They do this and she leaves. . . . Jorge happily tells Ms. Hart what the weight of the petri dish is. She asks him if he zeroed the balance before he started. Jorge answers, "Yes." Then Ms. Hart asks, "What would be the easiest way to get 11.5 grams of baking soda now?" Jorge answers something observer doesn't hear. Ms. Hart questions him some more and helps him come up with the answer. Then by way of review she asks, "Now what are you going to do?" He says, "Put in the baking soda." Ms. Hart says, "Until?" Jorge adds, "Until it gets to that mark." Ms. Hart says, "Right," and she leaves.

These kinds of teacher/student interactions during tasks were not isolated events. A good deal of instruction occurred during class work sessions. It should be noted that individual teacher/student interactions were often conducted at public voice levels, so "private" teacher assistance often served as a public resource to students who chose to listen. Nevertheless, the teacher was frequently asked the same questions over and over, and she repeated some demonstrations for different students many times.

In addition to core assignments, which were the focus of most instruction and class time, students who wanted B or A grades in Ms. Hart's class also had to complete extension activities. These were chosen from several options, including additional lab exercises, textbook assignments, reports, or posters. Most of this work was done outside of class and, except for explanations of the assignments and

requirements and some brief tips or reminders, very little instruction was provided for these assignments. A few students worked on the B lab in class after they had finished other work, and the teacher was observed monitoring and assisting at least one of these students.

Three boys attempted the A lab assignment, however, and the teacher devoted considerable time and effort to instructing and assisting this group during class lab w:k sessions. A fairly detailed description of these instructional interventions is included in a case study of one of the students, David R. Appendix A is an excerpt from this case study. The excerpt illustrates the questioning and guiding strategies Ms. Hart used in her efforts to help the group complete the task with understanding. It also suggests first, the difficulty of balancing direct and indirect instruction when objectives include development of student problem solving abilities, and second, the difficulty of providing such instruction to all students at appropriate levels in a classroom setting. Of the three boys in the group, two were successful at the task and appeared to understand the concepts involved. One was less successful, and his performance on a subsequent test over the two related, required labs indicated he probably did not understand the work at all. In addition, providing such extended instruction to one group of students during class reduced Ms. Hart's ability to monitor performance of all the class. This was one of several trade-offs between management efficiency and instructional concerns observed in this class.

Ms. Daniel's Science Class

In this eighth-grade science class, most tasks were short term and emphasized memorization or recognition, rather than comprehension. The class periods ran smoothly; students completed a large number of tasks and were introduced to a great amount of science content during the 6 weeks observed. Three major topics were covered: (a) structure and function of the circulatory system; (b) structure and function of the digestive system and facts about nutrition; and (c) science fair projects in which each student reported on an experiment, constructed a model, or completed a research paper. An assortment of other topics received minor coverage: the excretory system, general health facts, Black history and folklore, bacteria, and general survey of insects and reptiles.

Content instruction--task relationships. Table 1 shows that during a little more than one fourth of observed class time the teacher was engaged in active instruction. Much of class time was occupied by student work on tasks--seatwork tasks or laboratory exercises--without active instruction or assistance from the teacher. Most (84%) of active instruction time consisted of whole-class presentations by the teacher. Considered in light of the overall task system of the class, these presentations were separate from, and not critical for, accomplishment of most student tasks. Although there were content relationships across teacher lectures and student assignments, these relationships were never emphasized or clarified by the teacher. With the exception of four tests, which were very limited in scope, most student tasks were self-contained. That is, they did not require students to use knowledge acquired in teacher presentations or previous tasks. Laboratory

exercises or other tasks were not followed by concept development discussions, and the teacher did not refer directly to the lab work or other previous tasks during major content presentations. Assignments were usually introduced by brief teacher comments about the purpose or rationale of the activity and explanation of directions. On only two occasions in 6 weeks were post-lab discussions observed, and these were extremely limited. For example:

> At 2:41 the teacher tells students to wipe off the sinks because they are wet and make sure everything has been handed in. Jason cleans off the sink and so does Bernard. At 2:42 the teacher says, "Your question was, 'Are different parts of the tongue sensitive to different tastes?' Is that so?" Several students call out, "Yes." The teacher asks the students what that has to do with digestion. There are a few student callouts, none of which the observer can hear or distinguish. The teacher says to the class that thinking (about food) or activity of the senses does what? Again, there are student callouts which the observer cannot distinguish. The teacher tells students that it activates the digestion system; that taste does this. At 2:44 the teacher tells the students that they can talk for the last minute. (2/4/83, p. 7)

After a laboratory assignment in which students conducted test-tube simulations of action of gastric juices on protein, an extremely limited discussion did little to clarify the meaning of the students' experience. On that occasion, Ms. Daniel directed some students to clean the sinks, then initiated the following 1-minute discussion:

> The teacher asks the class, "Does food release energy?" Students say, "Yes." She asks them if they got a chemical change. Students answer "Yes" again. She asks, "How do you know?" The students say that they got bubbles. She says, "So the chemical change created what?" The students answer, "Oxygen." The teacher says, "So when you take in food, what happens to it?" Students answer that they get energy. Ricky comments on someone saying that they get gas. The teacher ignores or doesn't hear this. At 2:40 the teacher asks the class, "What do I expect you to have tomorrow?" (2/10/83, p. 13)

Directions for these tasks were often brief, sometimes clear, well organized and thorough and other times somewhat vague or disorganized.

Students usually asked few questions, but got right to work, conferring among themselves about what to do. (On all tasks, except tests, students worked together.) The teacher seldom instructed or assisted students while they worked on assignments. Seatwork assignments were often checked in class, but student answers were never discussed. They were announced, students checked and graded each other's papers, and grades were called out.

Limited, whole-class instruction and individual instruction in the form of conferences with students were directed at helping students with the only long-term task in this class, a science fair project consisting of an experiment, a research paper, or a model. Some instruction relating to this task was provided in the months before observations began. During the 6 weeks observed, students worked on their projects outside of class and during several class meetings. The teacher indicated in her interview that an important purpose of this assignment (and a major goal of her class) was to teach students scientific methods. There was, however, very little explicit instructions directed to the concepts and processes involved in this major task. Three brief, whole-class instruction episodes focused mostly on procedural aspects and requirements. For example, at the beginning of a class work/individual conference period for this assignment:

> She now tells them that they will be writing on the science fair projects while they watch a film. The teacher says she will be interviewing students one at a time as they do this. First she asks the class what a periodical is. No one knows. The teacher explains that periodicals are magazines, and she tells students who they may talk to in the library if they need help to find periodicals for their science fair projects. At 2:08 the teacher asks, "Who has started their abstract?" Barbara raises her hand and the teacher asks her how she began her abstract. Barbara reads her first sentence, which is something like, "My experiment is . . . bacteria." The teacher tells the students that an

> abstract is to tell what you did in 25 words or less. The teacher gives an oral example. . . ." The teacher tells the students that if they are doing an experiment, they need a control. She asks if there are any questions, and there are none. (1/28/83, pp. 3-4)

On two other days the teacher clarified the definition of the terms "hypothesis" and "review of literature" and discussed display board requirements and other due dates or requirements for the task.

On two occasions students had individual conferences with the teacher on their progress. For the first conference the teacher met with every student. These interactions were brief, 1 to 3 minutes, and the observer could not hear content of the interactions. On the second occasion, the teacher invited students who needed help to confer with her. None of these conferences seemed to provide instruction over content, meaning, or science processes, although some, as in the following excerpts, focused on requirements for different sections of the notebook or report:

> Jason now goes up to the teacher and tells her he has forgotten his hypothesis. The teacher appears disgusted with this bit of news, but looks through her papers for Jason's original hypothesis. The teacher reads it to Jason but then comments that this is not acceptable, and she rewords Jason's hypothese to be, "Alcohol will affect fish." Jason writes this down in his notebook and then returns to his seat. . . .
>
> . . . The teacher is now telling Vicky that the introduction is a longer form of the abstract, but that she should also tell why she wants to do what she is doing in this introduction. She tells her to give some background by saying something like, [Teacher gives an example.]. (2/1/83, pp. 6-7)

The following excerpts illustrate the most common focus of these conferences, mechanical or procedural problems:

> Felix is up at the teacher's desk at 2:22. The teacher says things like, "Are they all alike? How long have they been planted?" The teacher tells him to get more seeds and that they may sprout yet. She tells him he still has a week to do the experiment. It appears that Felix planted some seeds, none of which grew.

> . . . The teacher tells Frank that he needs more background, that is to say, why you want to find out if ants can endure heat or not. The teacher now seems to be discussing the fact that Frank also wants to subject ants to cold, but his mother will not let him use the refrigerator. The teacher is making a suggestion about using ice cubes. (2/1/83, pp. 6-7)

Thus, content instruction directed at the science fair projects, like much other instruction in this class, seemed to do little to help students make sense of the work and information they encountered in the class.

Content instruction strategies and problems. On eight occasions Ms. Daniel presented lectures, whole-class presentations and explanations of new content. These ranged from 7 to 53 minutes in length, and they were engaging, well organized presentations. Half began with brief reviews, questions directed to the class, or teacher statements of related content from the previous lecture (not previous tasks). Students were required to take notes on all but one lecture, and Ms. Daniel gave clear signals about what to put in notes. The following narrative excerpt suggests the kind of content and presentation strategies she typically used.

> The teacher says that white blood cells live for about 12 to 48 hours. Most students are not writing, but simply listening at this time. The teachers repeats her last statement slowly, and all students began to write again. Then, she says that lymphocytes can live for weeks, but that it varies. The teacher says that the average adult has about 30 trillion red blood cells. All students continue writing. At 2:16 the teacher is saying that there are a billion red blood cells in a single drop of blood. The students are impressed by this. The teacher is now saying that for every 10 to 20 red blood cells there is one platelet. One student calls out and asks for a repeat of this information, which the teacher gives. The teacher asks the students where the blood cells are made. Several students call out, "bone marrow." The teacher tells the students to write that down, and tells them that they should write down the following also: Red blood cells are made in the bone marrow with the help of the spleen, liver, stomach, and lymph glands. The teacher asks if everyone is with her at 2:18. A

couple of students call out, "No," and the teacher repeats the information. (1/17/83, p. 10)

In other presentations, the teacher structured the information around prepared overhead transparencies, and students copied from the transparencies.

A second way in which the teacher emphasized main ideas during these largely descriptive presentations was by making explicit statements about what would be on the tests. There were four tests in this class--two in which students had to identify structures on diagrams, one in which they identified structures in a frog dissection, and a spelling test over structure terms from one test and related lectures. The following narrative excerpt shows how the teacher sometimes clearly indicated that certain information would be on tests and how it would be tested. (She did not mention, however, that other content, e.g., explanations of functions rather than structure, would not be tested.)

> The teacher now hands out some dittoed sheets on the digestive system at 1:56 and tells students that the test on the digestive system will look exactly like this. At 1:57 the teachers says she will go quickly through the digestive system, and students may fill in their handouts as she does so. . . . The teacher puts a transparency containing the same information as the student handouts on the overhead projector which is projected on a screen on the east wall. Students are to label their handouts as the teacher goes over the transparency identifying structures. . . The teacher now talks about food entering the stomach, which has three walls. She is saying that the stomach churns the food up and that this churned-up food is called chyme. She spells this for the class. The digestive structures are all labeled on this transparency. Students are copying the labeled structure from the transparency onto their dittoes. (2/7/83, p. 2)

After this presentation, students completed seatwork assignments on the same content, but they used ditto handouts that contained repetition of all information that was needed for the assignments. This same content

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was duplicated in textbook assignments as well. Repetition of information across presentations and assignments may have served to emphasize and help students remember information, but successive exposure to content did not build on or develop concepts from one task to another, and Ms. Daniel's instructional presentations did not serve to integrate content.

Ms. Daniel questioned students at the beginning, during, and at the end of many instructional presentations. Often these questions appeared to serve more as emphasis of important information than as assessment of student comprehension, because she rarely called on nonvolunteers and often accepted callouts. In addition, students often answered questions by reading from their notes or the chalkboard. The following narrative excerpt illustrates some of the ways that questions were used:

> The teacher asks the students, "What is the solid part of the blood?" Students call out, "Cells," and then the teacher asks, "What is the liquid part of the blood?" Students call out "Plasma." The teacher continues, saying that plasma is the liquid part of the blood and that it transports water and nutrients received from food, minerals, and hormones to all the cells, and takes wastes from the cells to the kidneys. The teacher asks the class what "transport" means, and the students call out, "Carry." . . . At 2:12 the teacher is questioning students for understanding concerning the information she has been presenting. She tells the students not to read from their notes as they answer. Students raise their hands and give parts of the definitions the teacher has asked for. Two to three students are called on by the teacher, and they all give correct, but partial answers. . . . The teacher asks what red blood cells do. A student raises his hand and says that they carry oxygen. The teacher asks what part of it carries oxygen. There are several incorrect student callouts answering this question. One student finally calls out the correct answer, which was hemoglobin. . . . The teacher asks what is a person called whose blood does not clot. There are several student callouts, which are incorrect. The teacher eventually gives the answer, which was a hemophiliac. (1/17/83/, pp. 7-8)

On at least one occasion, after the teacher's presentation over heart structure, she used questioning to provide practice and/or assess student knowledge:

> At 2:28 the teacher asks for volunteers and calls on Kelly when he raises his hand. The teacher points to the vessels and various parts of the heart diagram on the bulletin board and asks the student which part she is pointing to. Kelly answers correctly and returns to his seat. . . . The teacher goes through the same procedure, calling on Frank and then Jason who both volunteer. . . . The teacher calls on another nonvolunteer, Rose, who also goes up to the diagram and correctly answers the teacher's question, and then returns to her seat. . . . The teacher now calls on Judith and asks a question. This student answers incorrectly. The teacher now asks Felix a question which he answers incorrectly also. The teacher then gives the correct answer. (1/20/83, pp. 9-10)

Ms. Daniel usually responded to incorrect student answers by indicating they were wrong and repeating her question or by supplying the answer herself. Incorrect responses were almost never discussed or corrected with explanations. Reasoning--correct or erroneous--was not a focus of discussion in Ms. Daniel's class.

Ms. Paul's English Class

Occurrence of content instruction. In this eighth-grade English class, active instruction focused on grammar tasks, spelling tasks, and literature, with most instructional episodes addressing verb usage, sentence patterns and pronouns. Little instruction was provided to support other tasks observed during this 6 weeks--journal writing (an established routine), an out-of-class composition assignment, and a notebook test. Table 1 shows that during about 40% of observed class time Ms. Paul was engaged in active instruction. During most (75%) of this time she conducted whole-class presentations and recitations, but she also often actively instructed individual students while they worked on tasks. About 20% of her instruction was directed to individual students. On only one day, a major test day, was no active instruction observed, and on most days Ms. Paul worked actively with her students in two or three separate instructional segments. Small group instruction was observed only three times: twice the teacher worked with a spelling group and once she met with a small group of students who had previously missed instruction for a writing assignment. Occasionally an aide provided some assistance, usually small-group spelling instruction, but instruction conducted by the aide was not included in the instuctional profile for Ms. Paul's class.

Content instruction--task relationships. In relation to the overall task system in this class, the content instruction Ms. Paul provided played several roles: (a) presentation and development of new concepts and information; (b) assistance, feedback, and guidance of individual students during some tasks; (c) discussion and review of tasks after completion; (d) brief review of related content,

direction-giving, and brief guided practice before some tasks; and (e) comprehensive review and guided practice before a major test. Almost all content instruction was directly related to tasks, and most tasks and content development episodes extended or elaborated on previous lessons.

Content instruction strategies and problems. Whole-class instruction in Ms. Paul's class often roughly followed a deductive concept teaching pattern beginning with review of related concepts, new concept definition, illustration and explanation, followed by directed whole class practice that provided students experience with examples and nonexamples of the concept. Often there was a fourth step consisting of further elaboration or a more complex application of the concept. Several aspects of this pattern were illustrated in the verb lesson on 1/26/83, excerpted below:

> At 10:27:25, she (Ms. Paul) notes that the sentences so far have had only one verb. Now they will consider sentences with more than one verb and they need to add a new term to their notes: "Verb Phrase, a group of words that work together to function as one." The teacher writes an example on the board: "The dog was hit by the ball." The first step is to find the verb; the most obvious action is: hit. But there is another word that is always a verb: was. This is a verb phrase and you need to underline both of them. (She puts notation on the example sentence.) She tells them to be careful, check to see if there is another verb; it is a helper. At 10:29:42 she says there are other helpers, write these down. . . . At 10:31:47, the teacher puts up a new example: "I should help you with the dishes." The first step is to find the action; the most obvious is help (Darrell gives this answer). The second step is to look for helpers: should. Underline it (with two lines). . . . At 10:33:33 she gives a new example, "I should have been helping you with the dishes." She underlines helping and then asks Derrick for the helpers. He has some problems: identifies "you" as the first helper; teacher corrects and waits for an answer. He gives one helper. Jeff and Carol L. give the others. Teacher then says: Look how long the verb phrase is; underline the entire phrase. Finally she says, look for the action but be sure to look for the helpers. (1/26, pp. 5-6)

The directed practice above also illustrates how Ms. Paul tried to provide students with explicit explanations of processes they could follow to analyze sentence structure and decide on verb and pronoun forms. She modeled the use of these steps in thinking or decision strategy again and again, as in the following excerpt:

> The teacher puts patterns up again: SVa, SVaDO, SVlSC. She tells them they have to know these patterns or they will mess up. Then she tells them they have to follow the steps: find the verb; find the subject; decide whether the verb is action or linking, find the direct object (if there is one) or the subject complement (in the case of linking verbs). She tells them that to decide which pronoun, you must decide whether it is being used in the object case (i.e., as a direct object) or in the subject case (as a subject or a subject complement). (2/3/83, p. 5)

During directed practice after presentation of new content, checking and discussion of student work, and review for tests, the teacher guided students through application of rules, algorithms, and decision-making strategies. For example:

> She asks Darrell why the first answer is I. Darrell answers that it doesn't sound right. The teacher replies that this is not an acceptable reason; she wants a logical reason. She then tells them to follow her steps. If I am picking a subject I check the subject chart. It pays, then, to know which are subject case and which are object case. . . . At 10:43:55, they do the second example, again following the steps of finding the verb, finding the subject; what kind of verb; if action does it have a direct object; is there an "and", and if so then it's a compound something (direct object, subject, verb). Later another student says it doesn't sound right; teacher responds by saying that this is not a good enough reason. (2/2/83, pp. 7-8)

In her content presentations and discussions, Ms. Paul was persistent and usually successful in maintaining a focus on the main concepts being taught and on the strategies or processes she wanted her students to use.

During whole-class instruction, Ms. Paul made frequent use of student responses in building lessons. Often this involved the

teacher's beginning sentences and having students complete her sentences. She seldom lectured in the sense of giving lengthy presentations in which she completed all her own statements. Usually, she called on nonvolunteers and volunteers. Only rarely did she encourage student callouts, but for emphasis of rules she wanted the students to remember (e.g., Not is never a verb.), she called for choral response.

In choosing students to answer questions, Ms. Paul very often focused on lower achieving students, and this practice seemed to affect the pace of the class. For example, in the following narrative excerpt, notice how the teacher responded to public student errors by staying with the student, guiding him or her with questions or prompts until the student answered correctly.

> At 10:20:36 Jeff also has problems; the teacher tries to take him through it; he makes mistakes. She then puts the sentence on the board; she gives the verb and asks him what kind it is, and asks what can come after an action verb. She then writes the sentence patterns up again and takes him through the rest of the sentence. The contact is over a 10:22:35. The teacher then calls on Cindy. She has problems and is taken through the steps also. They repeat the "not" rule, Barbara first, then the class, then Keith, for not saying it when everybody else did. The teacher continues this pattern and the contact is over at 10:24:04. Al also has problems. She asks him to try one [he has been absent]; she uses the same prompting technique of taking him through the steps and having him complete her sentences. (2/2/83, pp. 4-5)

The observer noted that often the group lesson took on the character of a series of public tutoring sessions, which sometimes had the effect of interrupting the pace of the lesson and flow of signals from the teacher. The excerpts below illustrate this practice.

> At 10:22, the teacher asks Cindy what the verb is; Cindy gets it with help consisting of [the teacher] having her look closely at the verb, taking her through the steps of who or what smelled. This is a fairly long, almost private contact which is over at 10:24:17. The rest of class waits. (1/31/83, p. 4)

> The teacher then goes over Darrell's sentence with him, "She is dead." She prompts him into the conclusion that this being verb is used as a linking verb. She then prompts him to say that a being verb that is not linking is going to be a helper and thus part of a verb phrase. She then asks him to give a verb. He gives "run." They build the sentence, "She is running." The teacher goes over it with him. He then writes his own: She is dying. Contact is over at 10:35:30. This was essentially an almost private contact with some giggling among students as Darrell made his mistakes; almost an expectation of humor here, which seems reasonable given his past performances. (1/31/83, pp. 5-6)

Other parts of the narrative on that same date illustrate a problem associated with asking students to contribute to public lessons by answering open-ended or assembly-level questions. When Ms. Paul asked students to generate sentences which were used for analysis during lessons, problems frequently arose because students' sentences were either correct but too complicated or included a form the class had not studied yet. For example:

> (On the chalkboard) Carol wrote, "He appeared to be frightened." . . . The teacher begins to call on Sharon [to analyze Carol's sentence] and then says to avoid infinitives: Until they have studied these, stay away from "to be" and similar forms. The explanation will be too complicated now, and students won't understand what they need to know for the test. She then has Carol take out the "to be" and make it an action. Susan writes, "He appeared from nowhere." The teacher does this one for the class. Robert is called on for Annie's [sentence]. The teacher interrupts to have Annie simplify [her sentence]: Erase the clause, take out "that." The teacher again repeats that she doesn't want to go into complicated explanations that will confuse everyone for the test; she wants to save lengthy explanations. (1/31/83, pp. 4-5)

Instruction directed to individual students during seatwork was usually in response to student requests by raising their hands, but Ms. Paul also provided prompts, hints, repetition of directions, and corrections to some students when she inspected their work. Individual instruction often consisted of piloting students through steps, in the same fashion observed during whole-class instruction in this class.

During many seatwork episodes, the teacher constantly circulated from student to student, answering questions and instructing. Sometimes these private contacts initiated whole-class announcements or re-explanations, and on one occasion, a 6-minute segment of whole-class instruction.

While many private teacher-student contacts were not heard by the observers, much of this instructional interaction was audible. The narrative on 2/1/83 illustrates the nature and frequency of teacher assistance during a grammar assignment.

> At 10:45:07 she tells them to get started so that she can help if they have trouble. There are immediate questions from Alberto and Sonja, which the teacher answers at middle range. At 10:46:15, the teacher moves to the west side and repeats the directions for Derrick again. She then has a contact with Carol L. during which the teacher does an example for her. At 10:48, the teacher helps Michael. Carol L. puts up her hand for help. The teacher gets back to her at 10:48:24. At 10:48:34, the teacher goes on to Molly B. (tells her to label the verb as action or linking), and she reviews the algorithm and does one item from the worksheet for Molly. Karen wants help. At 10:49:20, the teacher announces publicly, "'What' can be an interrogative pronoun." The teacher goes to Karen and prompts her with one of the items on the worksheet. At 10:50, the teacher roves around the room. She tells Derrick to work. She then goes to Frank, comments that he should have written down the examples they went over, and goes over the instructions with him and walks him through an example. (2/1/83, pp. 9-10)

The narrative on 1/28/83 provided a good illustration of the kind of tutoring that was needed when Ms. Paul asked students to do a relatively simple but comprehension-level task. The assignment required students to <u>compose</u> sentences to fit different sentence patterns (e.g., Write a sentence that has a proper noun for a subject and a common noun for a subject complement; write two sentences with the word "appeared," one with it used as a linking verb and one as an action verb.). Helping students, especially slower students, to complete this assignment

successfully seemed to require steady tutoring and contact. Sometimes the teacher walked students through steps. Other times she actually did the composing for them, as with Darrell in the following example:

> At 10:35:56, the teacher gets to Al; he asks if a pronoun is a common noun; the teacher says that it is a substitute for a noun. The teacher goes to Jeff briefly, then to Paul to clarify an answer. Then the teacher goes to Ellen at 10:37 for a student-initiated check of what Ellen is doing. Then, she goes to Darrell [teacher initiated] and writes out the analysis steps on his paper, and then goes through an item from the worksheet, correcting his work. Jane and Jeff have hands up requesting help. At 10:39, the teacher goes to Jane and writes out the analysis steps on her paper. Jeff talks to Al about the worksheet and apparently doesn't get an answer directly. Xiao and Sharon talk about the exercises. The teacher's contact with Jane is over at 10:41, and the teacher goes back to Darrell to check what he is doing, then to Carol L., and then to Jeff to tell him to have confidence, he is doing it. She then goes to LaTonya and walks her through an example. At 10:42:40, the teacher goes to Carol L. At 10:43, Molly B. goes to the blue table to collate for the teacher. Al is finished, idle. There is some restlessness in the room now. The teacher is working with Darrell, and the contact is over at 10:44:30. Robert is finished. The teacher goes to Darrell, writes out an example and goes through it with him. (1/28/83, pp. 5-6)

Ms. Paul managed to keep almost all of her students productively engaged during these work sessions, ranging in length from 5 to 23 minutes. (Only one was longer than 17 minutes.) As the narrative excerpts above suggest, however, this instruction was not easily managed, and it required a lot of the teacher's energy and effort. The same might be said of Ms. Paul's whole-class instructional practices. Both the high levels of student engagement she sustained and her record of success with her classes' English achievement gains during previous years suggest that she had the skill to utilize these content instruction strategies successfully.

Ms. Rogers' English Class

Occurrence of content instruction. In Ms. Rogers' seventh-grade English class active, whole-class instruction was a prominent feature. During the 6 weeks observed, active instruction was provided during about 44% of observed class time, with most instruction (91%) delivered in whole-class presentations or recitations. Much content instruction focused on parts of speech including sentence diagramming (28% of active instruction time) and on paragraph composition (26% of active instruction time). There was also content instruction on sentence punctuation and capitalization rules (21%), literature (17%), and spelling (5%). Instruction of individual students during seatwork was limited. Ms. Rogers monitored student work during class, but appeared to have kept her interactions with students brief and private. She was was never observed instructing small groups.

Content instruction--task relationships. In typical class meetings, Ms. Rogers conducted two or more whole-class instruction sessions, which usually led directly to written assignments for the students. Checking and discussion of some assignments were also occasions for active instruction, with teacher-led discussion of answers, errors, justification for answers, and review of relevant rules or other information. Ms. Rogers usually planned her lessons so that two or more of these topics were addressed by some direct instruction each day. On some days she presented several short lessons, and on one day she conducted six separate instructional episodes: an 8-minute presentation on comma rules, checking and discussion of a comma rule assignment, a 7-minute teacher presentation introducing a new composition unit, a short spelling lesson, 6 minutes of instruction on

diagramming sentences, and 5 minutes in which the teacher actively provided instruction to individuals while they worked on a diagramming assignment.

Within each topic area, content presentations followed logical, well articulated sequences of instructional episodes and tasks from day to day. For example, a unit on comparison/contrast paragraphs was developed across seven instructional episodes beginning with a brief introductory presentation on one day, followed on successive days by four lessons in which steps in producing a comparison/contrast paragraph were explained, practiced, and discussed, with student writing assignments requiring gradually more independent work, and ending with two lessons in which students had to generate their own paragraphs following the teacher's formula and instruction.

Content instruction strategies and problems. In composition instruction as well as on grammar topics, Ms. Rogers presented methodical, explicit explanations that often seemed to be directed at providing students with formulas or algorithms for simplifying and routinizing composition or sentence analysis processes. For example, before an assignment to write a "reason and example" paragraph, she led the class in practice "composing" exercises following a specific outline, as in the following example:

> At 10:18:24 she tells the students to get their journals out. She has the students look at the side board and informs them that they are going to turn one of their "Speak-out" journal entries into a perfect, reason-and-example paragraph. She prepares to go through an outline with them on the board by writing Roman numerals, capital letters, and numbers on the board. At 10:21:56 she calls on student volunteers to complete the outline on the board. She goes through an explanation of the topic sentence and then follows through with reasons, examples, transitions, etc., in appropriate places. When she is finished the example on the board looks like the following:

Topic sentence--state your opinion on subject
A. Reason 1 (In the first place,)
1. Example
B. Reason 2 (Secondly,)
1. Example
C. Reason 3 (Finally,)
1. Example
D. In conclusion,
Restate topic sentence
(1/18/83, p. 4)

When Ms. Rogers began the unit on writing comparison/contrast paragraphs, she prescribed a five-step formula students were to use. This consisted of (a) brainstorming to generate comparison/contrast items, (b) selection of three categories of items, (c) outline, (d) rough draft, and (e) final draft. In a series of whole class lessons, the teacher led students through these steps using different topics and modeling the process students were to eventually use in their own paragraphs. The steps and their applications were explained, discussed, and applied many times. For example, the teacher reviewed the steps used on the previous day:

> At 10:13:21 the teacher tells the students to take out one sheet of paper. She asks the students to try to remember the steps from yesterday that they went through about apples and oranges. She asks Lana if she recalls the first step and what it is called. Lana volunteers the answer, "Brainstorming." The teacher appears to be very impressed that she remembered. After a brief explanation of what brainstorming involves, that is, collecting as many ideas or jotting down as many ideas as possible, the teacher then asks for the second step from yesterday. Lucy volunteers and answers with, "Come up with three categories." The teacher nods her head in affirmation, and asks Dennis if he can remember from yesterday what the three categories were that they came up with. Dennis says, "Size, color, and shape." The teacher says, "Yes," as she writes these on the board. She then asks for the third step from yesterday. Fiona volunteers her answer, "Outline." The teacher confirms this answer and adds it to the other two steps that she has written on the board.

After this review, the teacher introduced a slightly different problem for students to work on, using the same formula:

> At 10:17:33 the teacher calls attention to today's assignment which is on the front board and reads, "Explain which would be better to carry to school in your lunch, an apple or an orange." She asks if yesterday's categories of size, color, and shape would be relevant for today's assignment. There is a pause of about 15 or 20 seconds before a student quietly says, "No." The teacher picks up on this and more emphatically repeats, "No. Size would not have any thing to do with what we were talking about today." She then asks about the other two categories of shape and color, and the students agree that these should not have anything to do with their topic today either. At 10:21:30 she tells the students they are going to have approximately 5 minutes, and during this time they are come up with at least five categories for deciding which [fruit] to take in their lunch. . . . At 10:25:52 the timer rings. The teacher explains that coming up with categories is the most difficult part of the whole paper writing procedure. She calls on students to share their categories. As she calls on the students she writes their categories on the board. . . . At 10:30:20 the teacher asks the class which of those six categories up there would be the three most important in answering today's assignment question. The class agrees upon messiness, taste, and price. The teacher then says that they should come up with an outline for this. In formulating the outline she asks Perry, "What it the first step?" Perry answers, "The topic sentence." And the teacher says, "You're absolutely correct. You would state which one would be better to bring." (1/26/83, pp. 3-5)

In the following excerpt of instruction that preceded a sentence diagramming assignment, Ms. Rogers called students' attention to the steps they should take and the questions they should ask themselves:

> After she explains the directions the teacher then says, "Look up here." She is standing at the front of the room, and says, "I have to show you something first." The teacher says that the steps that they are going to follow now are the steps that they should follow. The teacher then reads the sentence which is written on the board at the front and then begins diagramming it. The teacher calls on volunteers who supply partial answers. The teacher begins with the subject, then goes on to the verb; the teacher is not getting very many volunteers at this point. The teacher then turns to diagramming the adjective and she asks, "Do we have any words which describe the subject?" She is getting more volunteers at this point. The teacher calls on a student who supplies a correct answer. After this answer the teacher tells the class what adjectives can do, then asks if there are any other adjectives for the subject in the sentence. She agains calls on students, and after calling on two who answer incorrectly, she finally calls on a student who answers correctly. After each incorrect answer the teacher explains why the answer is incorrect, saying that the word offered by the student is not an adjective and does not describe

> the subject. The teacher points out what the word does instead. At 10:24 the teacher turns to diagramming the adverbs in the sentence. . . . (1/24/84, pp. 14-15)

The narrative excerpts above also illustrate Ms. Rogers' use of questioning during instruction. She frequently called on volunteers and nonvolunteers, especially during review lessons, discussion of completed student work, and in group brainstorming or paragraph generating exercises. For example, in the following excerpt of a checking/discussion session focusing on students' diagrams of sentences, she managed to involve almost all the students in recitation:

> She quickly reviews where subjects go, where verbs go, and what parts of speech subject complements can be. She then goes to sentence number 1: "The apple tree was extremely rotten." She asks Xavier if the basic diagram line makes sense. That would be: Tree was rotten. Xavier says, "Yes." She then asks Janet where to put the two words "the" and "apple," and Janet correctly says to put them on a slanted line under the word "tree." She calls on Glenn to tell where to put the word, "extremely," and Glenn answers correctly by saying that it should be placed on a slanted line under the word "rotten." . . . The last sentence is number 5: "My older sister can be lovable." She calls on Patty to answer whether or not the basic diagram line is correct. Patty says no because the person who put the diagram on the board had left out the word "can." So Patty says that the word can had to be included in order to make the basic line correct. The teachers agrees and writes this in on the board. The teacher then calls on Gina and asks Gina what word the adjectives "my" and "older" are modifying. Gina answers, "Sister," which is correct. (2/3/83, pp. 2-3)

Structured recitations such as that above were easy for the teacher to manage, maintaining a brisk and smooth pace. Narratives of the composition lessons, in contrast, illustrate how more divergent, open-ended discussions were much more difficult for Ms. Rogers to manage. For example in the following lesson, she had difficulty eliciting answers that she expected and managing student participation:

> She then says that today we are going to interact; raise hands, don't shout out answers; they can copy down this material later but now they will be brainstorming to write a paragraph using comparison and contrast. She sets this up by holding up an apple

> and an orange and saying that tomorrow they will have visitors from outer space to eat an apple and an orange, but these visitors from outer space have not seen either one before. Thus, they will write a comparison and contrast paragraph to give the visitors so that they can easily recognize an apple and an orange. First, they will look at the objects to see how they are alike. . . . Next answer is that they are both fruit. She asks why this is important. The first couple of student answers are not very informative. Teacher finally says that she has been leading them down the wrong path. What can they do with the apple and orange: Eat it, it is edible. She writes this down, and asks what else. The next student comment is that they both have skin. At 10:11 the teacher reminds students not to shout out of turn. Other student responses, "Both have seeds, juice. They both taste good." Teacher comments that this is an opinion, some people don't like them, but you can include this if you want to. She then says they are missing one obvious thing. There are some student guesses, but not what the teacher wants. She says that they need to consider a contrast: How would the visitors be able to tell the difference between an apple or orange and an elephant. She gets "size", which is what she wanted. She then asks students to get more specific: It's small; how small; measurement estimate? One student replies, "Hand size, it fits your hand." The teacher likes this last one. At 10:13:30 a student says that apples and oranges do not float around. The teacher questions this one, but accepts it; she desists comments being called out and then says they are getting silly, which means they need to go on to contrast. How are these two things different? Student response: color. The teacher again desists call outs and tells them to listen. She stresses that they need to think of categories for contrast; this will make it easier. (1/25/83, pp. 6-7)

In a similar discussion on another day, there seemed to be some conflict between the teacher's desire to use student ideas and her need to control the content that was generated or selected for the group to use in outlining a paragraph together. The following excerpt suggests how Ms. Rogers usually maintained firm control; she had already planned the outcome of the "brainstorming":

> At 10:16 the teacher says they have enough under the category, animals. She asks the students to think of another category. One student volunteers the category of food. The teacher says this might work, but that they might import food. She asks a further question about food. Teacher calls on Dennis who makes a comment about fruit. The teacher finds this acceptable and elaborates on this answer. The teacher then says, "What else?" She calls on a student who says, "There aren't any McDonald's." The teacher says this is right, and there is some laughter in the classroom. Then

> the teacher says, "O.K., just look around the room. Look at one another. What would be different there?" Teacher calls on a student, who replies, "Clothes." The teacher says, "Right." . . . At 10:19 they are finished noting differences. The teacher then asks the class, "Which of these categories do you think are most important?" Quite a few students volunteer. The teacher calls on a student who names the three categories that she thinks are most important: food, clothes, and environment. The teacher says, "The category environment is the largest. That should have been picked first. . . . Teacher raises some objection to the selection of food as an important category, and she says that in this case it probably is not important for the story. At 10:21 the teacher writes three categories on the sideboard: environment, animals, and clothes. (2/8/83)

Thus, while using student responses to divergent questions to build a lesson introduced complications into Ms. Rogers' instructional presentations, she heavily steered and structured discussions. Her content presentations seldom seemed to lose their focus on the main concept or processes students were supposed to be learning. Sometimes she ended lessons with a restatement or summary of main points. Other times the main points of the lesson were emphasized by an immediately following task.

Discussion and Summary

The purpose of this study was to describe the role and nature of active content instruction observed in four junior high classes, considering instruction in relation to the overall task system in each class. The teachers who were observed were experienced and had reputations of effectiveness. The reputations of the two English teachers were also supported by standardized test data from previous classes, suggesting their general effectiveness with some English curriculum objectives.

Assessment of the effects of these teachers' verbal instruction behaviors on student learning is beyond the scope of this study. First, no reliable and valid measures of achievement relating to the lessons observed were available. Even if such measures had been used, this paper focuses on only one part of teaching--verbal instruction--that would have contributed to student performance on the post-tests. We can, however, consider the problems these teachers seemed to encounter in conducting content instruction and speculate on effects of these problems (and other characteristics of the instruction we observed) for different kinds of learning objectives.

Roles of Content Instruction

Two of the research questions that guided the case studies focused on the occurrence of instruction and its role in the task system of each class. Several generalizations about instruction seem to be well supported by this sample of four classes: Content instruction in secondary classrooms is highly variable, complex, requires skill at juggling a number of management and instructional variables; it varies with types of tasks as well as with different teachers' understanding of

the content and curriculum goals. Very routinized tasks or simple, recall level tasks in which students can rely on resources other than interactive instruction are less likely contexts for observing instruction than are more complex or ambiguous tasks. In addition, in some classes or with certain kinds of tasks, instruction may be more likely to occur during or after student work on tasks, rather than before, in content development presentation. These findings suggest the possibility that researchers who have reported finding little instruction happening in classrooms (Duffy & McIntyre, 1982; Good, Grouws, & Ebemeir, 1983; Ward & Tikunoff, 1982) may have been looking at unlikely settings or at the wrong times. This is not intended to suggest that some teachers' failure to provide meaningful instruction is not a problem, but only that the occurrence of instruction should be considered in light of the tasks in which it is embedded. Examining and comparing the roles that active instruction played in the four cases described in preceding sections of this paper suggests some of the variety of patterns that tasks and instruction take in classrooms.

In three classes, Ms. Hart's, Ms. Paul's, and Ms. Rogers', instruction played a major role in the classroom task system. These teachers provided substantial active assistance, explanation, and presentation of information; and these instructional episodes were directly related to, supportive of, and integrated with tasks that students accomplished. Especially in Ms. Hart's and Ms. Paul's classes, instruction occurred both in whole-class and individual-student settings, preceding, during, and following student work on tasks, and it often focused on students' reasoning as well as facts and procedures for

tasks. More complex, comprehension level tasks were associated with more active instruction.

In contrast, in Ms. Daniel's class, teacher explanations played a minor role, at least with regard to the task system. In this activity and management driven task system, content of teacher's presentations and explanations was not critical for accomplishment of most tasks, which were often routinized and familiar. Teacher presentations focused on descriptive information, and there was almost no discussion of tasks, problems students encountered in tasks, the meaning of tasks, or their relationship to content presentations. A consideration here is that the curriculum units observed in Ms. Daniel's class (with the exception of the science fair project) might be interpreted as largely descriptive (recall level) in nature, not problem centered. Certainly, Ms. Daniel's instruction suggests that she made such an interpretation. At any rate, the kind of curriculum objectives teachers choose to address certainly is a variable affecting the nature and content of tasks and interactive instruction. In addition, Ms. Daniel's decisions about instructional strategies, the content she presented and the tasks she assigned reflect her knowledge of how to manage groups of students efficiently and engage them in activities, as well as her assumptions about the purposes of science instruction and her level of understanding of the content.

Managing Instructional Interactions

The third research question guiding these case studies focused on content instruction strategies and problems teachers appeared to have encountered in conducting lessons. Several patterns emerged from this analysis. In these four classes, student responses were often used in building presentations. This occurred during complex grammar lessons in

Ms. Paul's class, in composition lessons by Ms. Rogers, in discussion of experimental design considerations in Ms. Hart's class, and in some of Ms. Daniel's lectures. Especially in Ms. Paul's class, some of these content development sessions seemed to serve several purposes: concept explication and development, recitation in which the teacher assessed students' comprehension, and provision of direct, semi-private instruction directed to individuals. Some of the resulting lessons were not easy to conduct nor (from the observer's perspective) easy to follow. Concentrating on individual students during whole-class presentations caused pacing difficulties and made it difficult for the teacher to maintain a steady flow of signals to the class as a whole.

In both of the science classes, whole-class instruction seemed to be more often directed toward informing, presenting information and explanations, with little methodical assessment of student comprehension or conceptions. (Ms. Hart seemed to address student misconceptions occasionally in individual instruction or in response to the class's written performance; Ms. Daniel did not appear to do so at all.)

While these four experienced teachers seemed to have little difficulty conducting class discussions that utilized convergent questioning, using student responses when content was complex or questions were divergent often resulted in problems. Teachers sometimes had to deal with students' public contributions that were correct but too complicated (potentially confusing to the class) or that didn't fit the predetermined direction of the lesson. Other problems in managing public information were encountered in responding to student contributions or answers. In some lessons (e.g., Ms. Hart's), teachers' responses to student contributions sometimes detracted from a clear

focus on the main ideas of the discussion. In both content areas, especially when concepts or algorithms were complex, teachers' responses to student errors could be a source of problems. Correcting and explaining errors or incomplete answers sometimes slowed the pace and interrupted the focus of lessons. However, allowing incomplete or partly inaccurate responses to slide by eroded the accuracy and clarity of public information in the class. An example of the latter case was observed in Ms. Hart's class. Interaction over a complex concept--mass and weight--occurred frequently across several weeks. With repetition, the teacher tended to accept more simple, but less accurate and complete versions of student answers to the question of the difference between mass and weight. The class's performance on two related tasks suggests that the resulting shorthand version of the "truth" did not help students understand the concepts involved.

Some Instruction and Learning Issues

Many of the patterns that were apparent on close examination of occasions of active instruction in these four classes can be summarized in terms of four sets of problems or areas of tension, which these teachers handled in different ways.

1. Content coverage versus thorough instruction. Research on concept teaching and learning (e.g., Posner, 1982; Smith & Anderson, 1984) and on instruction for problem solving (see review by Heller et al., 1983) suggests that effective instruction for such objectives requires that less material be taught in greater depth, with a focus on student progress rather than on a quantity of material covered. Discussion of tasks, redundant instruction, assessing and addressing students' misconceptions, providing students with opportunities to apply

concepts in different contexts, modeling solution processes, and allowing students to talk about processes all take time. There are ever-present pressures in classrooms for teachers to move on to the next topic or unit. One solution to this dilemma was seen in several of our classes: careful integration and overlapping of tasks and content instruction so that lessons were cumulative, providing review and application of some content while introducing new content. One of the teachers, Ms. Hart, also limited the content she attempted in 7 weeks.

2. Balancing teacher control of content and pacing with active student involvement in lessons. Research has underscored the importance of maintaining clear focus on main concepts (Roth et al., 1983) and process objectives (Roehler et al., 1983) during lessons. Presenting content clearly (McCaleb & White, 1980; Smith & Land, 1981) and managing the pace of lessons (Doyle, 1979) are also important. On the other hand, providing students with opportunities for verbal practice with concepts and discussion of reasoning processes is critical (Heller et al., 1983; Roehler et al., 1983) as are opportunities for teachers to assess student comprehension of lessons and their initial understanding of concepts (Roehler et al., 1983; Roth et al., 1983). The four cases in this study demonstrated that student involvement in public lessons can often conflict with the teacher's need to manage content and pacing. Problems were more apparent when content of lessons was complex or students were required to make contributions that were divergent. Teachers in this study dealt with these tensions in a number of different ways, with different levels of success on different occasions. Some of the lessons observed here and some of the findings reported by

Roth et al. (1983) suggest that differentiating student involvement strategies according to the purpose of lessons may be a pertinent issue: direct, tightly teacher controlled presentations for clear explication of concepts and separate, more student-centered open-ended discussions for practice and assessment. One hypothesis is that teachers sometimes try to do too many separate functions simultaneously in an interactive lesson.

3. Coping with a range of student learning rates and comprehension levels. This ever-challenging aspect of classroom life forces teachers to make some decisions about, among other things, when and how to provide individualized instruction/assistance to students who request it or need it to engage in assignments. The observations reported here suggest that providing extended individual instruction during public lessons can be cumbersome and detract from whole-class lessons. On the other hand, providing individual tutoring to many students during work assignments can be inefficient and can conflict with classroom management tasks such as monitoring student behavior (e.g., in Ms. Hart's class). Small group instruction was not used by the four case study teachers, with the exception of some instruction of lab groups. In both science classes, peer help and collaboration sometimes supplemented or substituted for teacher assistance.

4. Providing appropriate amounts and kinds of direction and assistance for students on comprehension/problem solving tasks. Studying narratives of these four teachers' instruction in whole-class and individual interactions called attention to the following set of questions. When does direct instruction or assistance by the teacher

obviate students' grappling with a problem? What kind and amount of teacher intervention can help students accomplish comprehension level tasks without reducing or changing the task itself to a lesser task? Some instructional strategies of both English teachers in this study could be interpreted as efforts to formulize or routinize comprehension level tasks. Providing students with a five-step formula to follow rigidly in writing a paragraph or analyzing a sentence may side step comprehension level work for students, unless opportunities are provided for them to go beyond lock-step use of the formula or to apply it in a different and challenging situation. (Then, what kind of instruction/assistance should be provided to help different individuals succeed in the latter task?) Instructional assistance which removes all uncertainties for students deprives them of opportunity to take any leaps. On the other hand, when is indirect or purposely limited assistance no assistance (no instruction) at all? Thoughtful teachers grapple with these kinds of questions often, I believe. The case study of Ms. Hart trying to help three boys solve a problem without giving them all of the answer (Appendix A) illustrates this kind of struggle.

Many of the studies cited in the preceding paragraphs suggest some partial answers to the question of what kind of instructional strategies are likely to be helpful for comprehension level objectives. These four case study teachers used some of the recommended approaches in varying extents. Some of their solutions to the problem were also not instructional (see Doyle, 1984, for a discussion of how these teachers used class grading or accountability systems to accommodate student attempts at challenging tasks).

In sum, content instruction observed in these four case study classes reflected varying degrees of awareness and different solutions to the four problem areas identified above. From the perspective of classroom task systems, the classes varied greatly in the ways in which instruction supported academic tasks students accomplished. Observations suggest that these teachers differed in the ways they thought about instruction as it relates to the work for which they held students accountable. Designing, coordinating, and conducting tasks and instruction that supports those tasks in complex classroom settings is clearly a difficult job. The concept of content instruction as a resource for student task accomplishment might serve as a useful way for secondary teachers to think about their teaching.

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TABLE 1

Profiles of Active Instruction in Four Classes

	Ms. Hart	Ms. Daniel	Ms. Paul	Ms. Rogers
Content Area	Science	Science	English	English
Proportion of observed class time in active teacher instruction	.52	.28	.39	.44
Proportion of instruction time in whole class format	.68	.84	.75	.91
Proportion of instructional time in individual student format	.10	.13	.21	.09
Proportion of instruction time in small group format	.01	.02	.04	0
Proportion of instruction time in small group/individual mixed format	.20*	0	0	0
Most frequently occurring number of active instruction segments per class period	1	1	2	2
Range of instruction segments per class	0-3	0-4	0-4	1-6

*During laboratory assignments and related class work.

Appendix A

Excerpt from Student Case Study, Ms. Hart's Class:

Assisted Problem Solving

Excerpt from Student Case Study, Ms. Hart's Class:

Assisted Problem Solving

David R. and two other boys chose to do an optional experiment to complete their requirements for an A report card grade. This was one of three available choices, and it was presented to the class as the most difficult choice. The description of this assignment was included in the students' 6-weeks outline:

> Lab exercise: Scientific Method: Using the information obtained from Experiments 1 and 3 in Activity 6 (Tasks 11 and 12) in the Core Material, design an experiment in which you answer the following question: "Does density have an effect on the bouyance force exerted by a liquid?" Requirements: (a) This lab should be done neatly and in ink; (b) write on only one side of the paper; (c) this lab must be written up according to instructions given on the handout, "How to Write Up a Laboratory Activity," and you must include a written explanation of the procedures used. NOTE: Include a hypothesis as was done in Experiments 1 and 3 (Tasks 11 and 12), and your conclusion must state whether your hypothesis was correct or incorrect. This activity will be worth 20 points instead of the usual 10.

The laboratory procedures for this assignment had to be completed in the classroom laboratory during or after class. They were in fact done in class during the time that the class was working on Tasks 10, 11, and 12, and we have a good record of how the three students and the teacher accomplished the task. On Thursday, February 10, the teacher asked students who were interested in doing this optional activity to meet with her at the end of a class period. David R., David S. and John met privately with the teacher. She gave them some instructions and told them they would have to do the regular Core Assignments together as a group and to do them in the order 11, 12, 10. She said that this optional activity was tentatively due the 22nd.

David R. was probably the strongest student of the three. John B. was a B+ or A- student. David S. made lower grades, typically, and the teacher hinted that she had doubts that David S. would follow through. At this early point the teacher gave the three boys the impression that they would have to work after school, or at least she left that possibility open. On the first day of lab work, February 14, the three boys quickly completed the lab portions of two prerequisite assignments, Tasks 11 and 12 (other students in the room spent several days doing so). The teacher briefly checked their progress and their results, and at the end of the period she told them that they "need to figure out the design of their experiment now." When David R. asked, "On what question?", the teacher told him to look on the outline that she had given him.

On the following day, as soon as David R. joined his two partners at the lab table, he asked, "Do you understand our question?" He repeated this question several times until the other two boys responded. John B. said he didn't know what bouyancy meant. David R. agreed. He said he had no idea what the question meant. The question that they were referring to is the one written on the 6-weeks outline that the teacher gave them, "Does density have an effect on the bouyance force exerted by a liquid?" The term bouyancy had not been defined in class yet. However, it was the focus of the experiment they had done on the previous day. The boys had completed the experimental procedures in which they compared the weight of an object in water and in air, but they had not yet tried to answer the questions, which directed them to look up the definition of bouyancy and had them use this concept to explain their experimental results. After a few minutes David R.

approached the teacher requesting help. She joined them at their table and began to help them think through their experimental question. After several interruptions by other students requesting assistance with the regular assignment, she checked on the three boys' comprehension of prerequisite concepts in the following manner.

> She tells this group, "Now first let me see your lab. Have you finished number 3 (Task 12)?" They say yes although one of them admits they haven't done the questions. The teacher looks on David R.'s lab sheet. She asks David about the hypothesis he has written on this sheet, which is that alcohol would be more dense than water. She asks him if that was his hypothesis. He says, "Yes." She asks him if he still believes that. He says, "No." Then the teacher says, "Let me ask a question about (Task 11). Did the object weigh more in air or in water?" The three students answer, "Air." The teacher asks, "Why?" The students answer that, "Water was holding it up." The teacher asked, "What does that mean? What was holding it up?" (Brief interruption here.) The three boys in the group don't know the answer to the teacher's question. She tells them to answer the first four questions of the lab on bouyancy before proceeding. One of the boys asks if they have to write it down. She doesn't answer, but she intends them to write it down, and they do. She goes to the front and gets the room quieter. Meanwhile David S. looks up the word bouyancy in the glossary of his book. He reads the definition to David R. and David R. takes the book, thinks about it and nods. . . . The teacher returns to Group 6. She gets David R. to say that bouyancy is an upward force on an object in a liquid. The teacher reminds them, "You have determined in Experiment 1 (Task 11) that liquid has bouyancy and that the weight of an object is affected by bouyancy. Now let's look at Experiment 3 (Task 12)." She asks a few quick questions about Experiment 3, in which students compare the weights of equal volumes of water and alcohol. She says, "What does that mean, one gram per milliliter?" John B. and David R. answer, "One milliliter of water weighs one gram." . . . Then (of alcohol) the teacher says to the three boys, "So what does that .8 tell you?" The boys answer something like, "One milliliter weighs .8 of a gram." She turns to David R. and says, "So your hypothesis (on that experiment) was incorrect, right?" He agrees. The teacher tells the three boys to listen carefully while she reads the question for the A lab. . . . Then she asks, How could you put these two experiments together to design an experiment to answer your new question?" Soon David R. tells the teacher that his hypothesis is that bouyancy would be affected by density. She replies, "How would you prove it?" He doesn't answer. She questions the other two boys briefly and then leaves the group saying, "Come on, I'm not going to give you the whole answer. You put this and this together to find the answer." . . . "You can use these experiments to plan your own experiment." The boys ask

her if they have to do the experiment as well. She assures them that they do.
At 3:07 David R. goes to the teacher to tell her his idea for the design of the experiment. His plan is to find two liquids of different density and to weigh something in the two liquids. The teacher asks him if he has to go and find something or does he already have them. He remembers that he can use water and alcohol. He goes back and reports to the other two boys that it's going to be easy, but he tells the teacher and the boys, "I know that you are going to grade it super hard." The teacher assures the group that she will grade it super hard and that their procedure had better be as specific as hers usually are. . . . The teacher tells the boys who are working on the A lab that they need to do the three assigned experiments first and then they need to plan this experiment and have a rough draft of the write-up of it Monday. They will be allowed to do it in class next week.

David R. and his two partners continued to work during most of the period on the task of stating a hypothesis and designing an experimental procedure to test it. Throughout the period, David repeatedly approached the teacher for assistance, confirmation, and negotiation of the task requirements. Soon both David R. and John B. had separately identified a hypothesis and had a plan for proceeding. The teacher took the third boy, David S., aside and worked with him privately for some time to help him solve the problem before the three were allowed to proceed. Later in that period David R. and his two partners worked both on the lab questions for the Core Assignment and on their optional activity. John B. began a draft of the procedure. David R. commented on it.

John tells David, "We don't need to weigh it in the air." David says, "Yes, we do. We have to be thorough."

In the next class meeting, Wednesday, David R. and his two partners completed the experimental procedures for the third required experiment, Task 10, "Does gas have mass and weight?", then they worked on their draft of the A lab procedures.

At 11:48 the teacher looks over the draft that David R. presents her for the A lab he is working on. She okays it. David R. says, "You want the procedure written out, don't you?" The teacher says, "Obviously."

Later that day the three boys discussed the schedule that they would use to do this A lab and the required activities. David R. commented to the other two that even if their lab was totally terrible they would get 5 points just for trying it. Teacher must have told him so privately.

There was no class the next day, but on Friday David R. and his partners completed the experimental procedures for their optional lab and worked on writing it up. A lot of teacher prompting, and negotiating of requirements was seen that day.

David R. has brought his write up of the A lab for the teacher to okay. He stands by her, waiting. She says she'll bring it to him later; she needs a chance to read it. Then the teacher calls for John B., David R., and David S. She tells them that she wants them to write up their procedure well enough that she could give it to another girl to do as an optional activity, and this girl could follow the directions. . . . The three boys see this as a problem, however, because they hadn't planned to describe everything that they borrowed from Experiment 1 (Task 11) and Experiment 3 (Task 12) on which the A lab is largely based. The teacher tells them that they don't have to write everything that she wrote on Experiments 1 and 3. For example, they can just write, "Determine the density of alcohol." David R. is not satisfied with this, however. He argues, telling her that she should have told them that they would have to do this earlier. The boys walk off to their lab table in seeming disgust. As if to placate them, the teacher calls out that they don't have to turn this in until the 22nd. (Other optional activities are due on the 18th.) (Later) The teacher asks them what their hypothesis is. Observer doesn't hear their answer, but the teacher says, "So, less density means less bouyancy?" The students answer, "Yes."

The boys set up their equipment to compare the weight of an object hanging in alcohol with the weight of an object hanging in water.

First they weigh a heavy weight using a spring scale, with the weight hanging in a jar of alcohol. David R. says the weight is the same as it was in air. He goes and reports this to the teacher saying: "This balance is not delicate enough to tell the difference." The teacher seems not to have anticipated this problem. She hesitates then tells them to try a bigger weight.

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David R. gets the 500 gram weight and he and DAvid S. weigh it in the jar of alcohol, finding that it weighs "two lines less" or 450 grams. David R. says now he's got to rewrite his procedure using this figure weight.

Later David R. questioned the teacher still again about the extent to which they had to describe the procedures for Tasks 11 and 12. The teacher told him to "give just a skeleton idea," but he seemed dissatisfied with this answer. The boys worked alone a while and made some decisions about whether to use existing data or reweigh objects. However, the boys did not really obtain a solution to the problem without some content instruction from the teacher:

The teacher goes to Group A and reviews their results. The weight weighed 500 grams in air; 425 grams in water; and 450 grams in alcohol. She asks them, "What was your hypothesis?" One of them answers that their hypothesis was that the weight would weigh less in water. The teacher says, "No. What was your question?" One of them reads or says the question, "Does density have an effect on the buoyance force exerted by a liquid?" The boys say that their hypothesis or their results are yes it does. The teacher asks them how it does. One of the boys answers, "It makes it weigh less. The teacher asks, "So what about buoyancy?" She sends John B. off to get some chalk and she turns and writes on the side board the question, "Does density have an effect on buoyancy?" The three boys watch and listen. She writes down the three weights that were obtained, "Those are our results." Then she says, "Tell me what buoyance is?" John B. says something about it being an upward force. David R. interrupts saying, "I got it! The upward force is greater (in denser liquids) so that the weight is less." The teacher says, "Right!" and she leaves the group without further discussion or without checking whether the other two boys get the point of not. The other two boys act like they get the point, however, or they think they do.

After the group had the solution to their problem they turned to the issue of the write up again. David continued to approach the teacher with efforts to get her to make the requirements less ambiguous.